Fire versus Fungi; Forest and wildfire management options as climates aridify dangerously.

Forests globally confront increasing risks of wildfires as their fuel levels rise and climates aridify. These risks have also intensified as dense regrowth has regenerated after the primary forest was logged and fires and browsing by herbivores was suppressed in the regrowth forests. These risks have further intensified as regions have aridified due to climate change and fuel has accumulated with the death of many trees due to drought stresses and associated insect impacts.

This accumulation of forest fuels and the more arid less certain climate has also made fuel reduction burns too dangerous where liabilities and health risks from fire escapes, smoke and particulates are high or where skilled staff are not available. As a result many, formerly less fire prone forests and regions are now at extreme risk of wildfires, the loss of forests and their associated timber, natural capital, ecological and climate buffering values.

Communities urgently need safe solutions to avoid these increased wildfire risks and losses.

Fortunately, we can readily avoid many of these risks by simply bio-digesting these fuels naturally.

Forests naturally supported vast activities of leaf eating insects, grubs, termites, browsers and fungi in their soils that were highly effective in bio-converting excess forest biomass into dung, plant nutrient and stable soil carbon via humus and glomalin. We have grossly impaired these activities. By restoring and accelerating such natural fuel bio-conversion we can often greatly lower fire risks.

By increasing soil carbon levels we can also greatly increase the infiltration, retention and availability of rainwater and the nutrient dynamics and bio-fertility of these forest soils. The better soil structure enables roots to proliferate to depth and higher microbial activities to be sustained that enhance the productivity, resilience and healthy development of these forests and their value to communities.

Given that our management of these processes, governs to what extent forests accumulate fuel and thus their risk of fire and collapse or develop ever more productive soils by converting this fuel into stable soil carbon and nutrient cycles we are both directly responsible for and response able to limit these fires . We can choose if we let fire dominate to convert plant biomass back into CO_2 or help fungi and microbes in the soil and the intestines of herbivores convert it into stable soil carbon.

So what do we need to do to restore and accelerate this natural biological fuel reduction in forests? Given that most forests still retain most of the agents needed for this bio-conversion, but often at very reduced activity levels, we can readily re-stimulate their activity by providing them with or allowing them to create optimal substrate, nutrients and ecological conditions for these activities.

Often this simply involves thinning excess trees to provide the substrate, re-stimulating the processes driving the bio-conversion of litter into stable soil carbon and adequate time and rest. Where needed we can also re-introduce key natural herbivores such as beavers or browsing animals into these forests to help create local conditions to accelerate such bio-conversion processes.

Given the intensifying climate extremes and wildfire risks our key limiting factor to do this is time. Can we re-establish such biological fuel reduction fast and strategically enough in key at risk regions to provide the essential fire breaks and mosaic hazard reduction zones to limit these wildfire risks?

The ecological reduction of wildfire risks in the White Pine regrowth forests of New England USA.

The ecology of White Pine; regrowth, fire control and revitalization in the North East US.

White Pine, Pinus strobus typically regenerates naturally from seed after periodic wildfires to form dense stands that depending on site qualities form tall dense regrowth forests from 30 years of age that compete strongly for the limited light, soil nutrients and water in the increasing dry seasons. Where natural mycorrhizae can supply adequate essential nutrients and water these trees can grow to over 200 feet and produce some of the US's densest and highest value pole and sawlog forests.

Pinus strobus is also a pioneer coloniser in old field successions, as wind-blown seeds regenerate widely spaced trees often with multiple stems and thicker branches in these more degraded sites. These forests often dont develop as efficient fungal processes to bio-degrade and cycle forest litter into soil carbon and nutrients, resulting in the build up of more fuel that creates greater wildfire risk.

Large areas of natural white pine were cleared in the NE US over the past 300 years to create farms that degraded and were retired as better soils became available further west in the past 150 years. Much of this land has regenerated to extensive dense but poor quality white pine regrowth forest with now very high fuel levels. These are at risk of dangerous wildfires from lightening and arson as climate extremes increase and droughts periodically stress these regions.

Left unmanaged the high fuel loads in these extensive forests with large numbers of unprotected people, houses and villages now create severe wildfire and human risks that no level of intervention on extreme days could hope to prevent or limit. Options for fuel reduction burns are also limited as conditions are far too dangerous when it is dry enough to burn to prevent the spread of these fires.

Fortunately we still have natural options to safely reduce these fuel levels and thus wildfire risks as well aso re-vitalize the soils, hydrology, nutrient cycling, productivity and quality of these forests and their potential to regenerate sustainable ecological, social and economic benefits for communities

To do this we must accelerate the natural fungal bio-conversion of these fuels into stable soil carbon which in turn will increase the infiltration, retention and availability of water to depth in these soils. This will greatly reduce wildfire risks in these forests both by reducing fuel levels and by increasing the amount and longevity of water available from soils to lower fire risks even on extreme days.

The accelerated natural microbial bio-degradation of this biomass fuel should also significantly stimulate nutrient cycling rates and availabilities in these forests to aid their health and productivity.

As various factors may limit the rate of litter bio-degradation by fungi on different sites this may need to be remediated by relevant natural microbial bio-stimulants and management treatments. Neither the enhanced natural litter bio-degradation nor the treatments to stimulate it can adversely affect the health, bio-diversity, eco-system services or social amenity value of these forests beyond reducing the current acute wildfire and human risks and the insurance liabilities resulting from them.

Similar natural biological fuel and wildfire risk reduction strategies may be relevant well beyond the NE of the USA in protecting bio-systems and communities and in regenerating the hydrology and productivity of forests as climates aridify globally.

Demonstrating the effectiveness of these natural fuel and wildfire risk reduction strategies.

While natural and safe this strategy to reduce wildfire risks by accelerating the bio-conversion of forest fuels by fungi into stable soil carbon and increases in soil water retention and levels is novel. As such it needs to be demonstrated as to its practicality, veracity and ecological and social benefits.

To do this representative regrowth forests are needed to demonstrate the effectiveness of different treatments and monitor their long-term benefits relative to untreated and conventional controls.

Subject to detailed diagnoses of local site factors limiting this fungal bio-conversion and options for its natural bio-stimulation, these forest management treatments may involve;

1. The thinning of the overgrown regrowth forests to allow light to the forest floor and the re-establishment of ground covers and microbial processes to aid fuel bio-degradation.

2. The pruning of the remaining trees to remove fuel levels and bridges between the litter and canopy fuels to limit the risk of fires crowning and spreading.

3. The re-establishment of desired understorey plants in the forests to provide essential nutrients and conditions to aid the microbial bio-degradation of the residual litter.

4. The addition of natural bio-stimulants to aid the activity of fungi and other agents in the breakdown and cycling of nutrients in and from this litter.

5. The re-integration of natural herbivores to these forests to aid the browsing of ground cover, nutrient additions and cycling and the turnover of the fuel layers.

6. The utilization of the timber thinned from these forest via their local conversion into high value wood products providing local employment and industry opportunities.

7. The utilization of waste wood biomass from this thinning to grow high value mushrooms as local and wider food products to provide further employment and enterprise opportunities.

8. The integration of a wide range of high value shade tolerant understory crop options, such as berries, in these thinned forest stands to aid their productivity and viability.

9. Optimizing and accounting for the high carbon draw down potential of such thinned healthy regrowth forests in generating carbon and eco-system services offsets.

10. Maximizing the natural capital, ecological and equity value of these former degraded lands through these ecological forest, soil and hydrology regeneration processes.

Specific performance measures can then demonstrate and verify the superior performance of these treated sites in regard to each of the desired performance outcomes from reducing the wildfire risks and revitalizing the health of these regrowth forests relative to untreated regrowth forest controls.